

Progress of Sugar Glider, *Petaurus breviceps*, establishment at the Tower Hill State Game Reserve, Vic.

G.C. Suckling¹ and P. Goldstraw²

Introduction

In 1979 a program of release of captive-bred *P. breviceps* (Sugar Glider) was initiated at the Tower Hill State Game Reserve in south-western Victoria. The first release occurred in that year and subsequent releases were undertaken in 1980 and 1981. Artificial hollows were provided for shelter, because planted trees (approximately 17 years old) did not contain hollows.

A survey of *P. breviceps* at Tower Hill was conducted in May 1981. The results were reported in Suckling and Macfarlane (1983) who concluded that a population had probably been established at Tower Hill, but that continued monitoring would be necessary to substantiate that conclusion.

The present study was conducted in November 1986, to evaluate the continued survival of released *P. breviceps* at Tower Hill and further evaluate the status of the population.

Study Area

The study area and management history were described by Suckling and Macfarlane (1983). Tower Hill is the broad crater (approximately 3 km diameter) of one of Victoria's most recently active volcanoes (Fig. 1). The surrounding volcanic plains were settled by Europeans in the early 1840's. Clearing began soon after and much of the land on the three islands within the crater was cleared by 1861. By 1870 the islands were devoid of trees and the crater slopes were covered with bracken and grass. A restoration program commenced in 1961, when the area became a State Wildlife Reserve (Department of Conservation, Forests and Lands Records.)

¹Department of Conservation, Forests and Lands, 250 Victoria Parade, East Melbourne Vic. 3002.

²Department of Conservation, Forests and Lands, Warrnambool Vic 3280.

The present study was conducted on the main island, which comprises 130 ha of undulating land sheltered by the outer rim of the crater. A barrier of water usually separates this island and two smaller islands (48 and 1 ha) from the steep, treeless rim of the crater.

The canopy on the main island is mainly planted Manna Gum *Eucalyptus viminalis* Labill. and Swamp Gum *E. ovata* Labill. (to 20m in height), in mixture with planted Early Black Wattle *Acacia decurrens* (J. Wendl.) Willd. (to 10 m in height). Various other native species have been planted, the most conspicuous of which are Coast Sheoak *Casuarina stricta* Dryand. and Blackwood *Acacia melanoxylon* R. Br. The principal understorey species are Bracken, *Pteridium esculentum* (Forst.f.) Nakai, and various grasses. There are no hollows in any of the planted trees. However, 70 artificial hollows were erected in two sections of the study area during 1979 and 1980.

The release program was fully described by Suckling and Macfarlane (1983). Sugar gliders were first introduced at Tower Hill in November 1971; three adult animals and three juveniles were released (Department of Conservation, Forests and Lands records). At that time the eucalypt and wattle plantations were only 7 years old, and, as no adequate shelter was available for these animals, they probably perished. However, no surveys were conducted so this cannot be verified.

A subsequent program of introductions began in February 1979, when 26 juvenile gliders (12 male and 14 female) were released. In January and February 1980 34 additional gliders (21 males and 13 females) were released, and in February 1981, 12 tagged gliders (six male and six female) were released (D Hackett, personal communication; Department of Conservation, Forests and Lands records). Thus, the total

Research Reports

number of gliders introduced prior to the present study (excluding the 1971 releases) was 72. Virtually all of these gliders were reared in captivity by Mr Hackett, from stock that originated from various forested areas in south-eastern Australia

Methods

The Sugar Glider population was surveyed during November 1986. Trapping was conducted in the vicinity of the 1981 survey sites (see Suckling and Macfarlane 1983). Fifty-three wire-cage traps, 36 by 13 by 13cm, (Gordon Wire Specialties, Kew) were used; all were set for four consecutive nights. Traps were attached to eucalypt and wattle trees at heights ranging from 2 to

5m above ground. A mixture of honey and oats was used as bait and, as an additional attractant, a trail of dilute honey was laid from the trap to the main stem of the tree (Suckling 1980).

Each glider was tagged with one fingerling eartag (Salt Lake Stamp Co., U.S.A.); male gliders on the right ear and female gliders on the left ear. All gliders were examined to determine reproductive condition and age (Suckling 1984). Three age-classes were recognized on the basis of tooth wear: younger than 1 year, 1-2 years and older than 2 years.

All artificial hollows which could be located were examined with the aid of a ladder. Hollows with hinged lids (hollow-

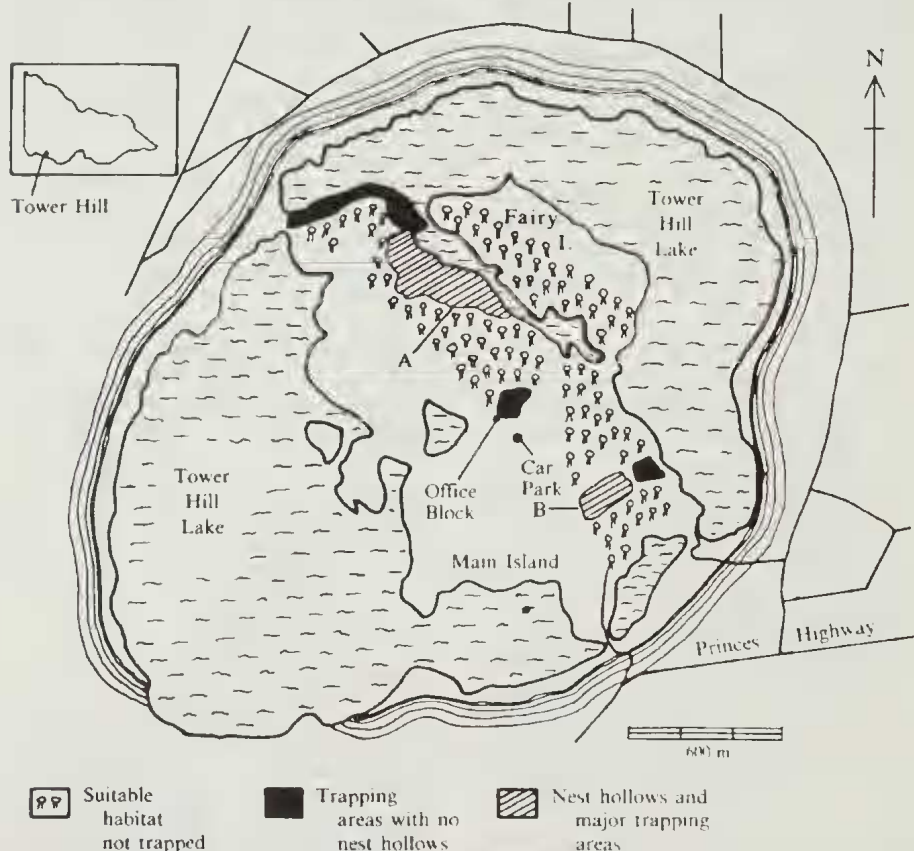


Fig. 1. The study area at Tower Hill State Game Reserve, showing distribution of trapping areas, nest hollows and suitable habitat not trapped, May 1981.

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limb types) and terra-cotta pipes were thoroughly checked; box-type hollows which lacked inspection doors were disturbed by knocking vigorously on the box and poking a stick into the exit hole, in an attempt to flush all resident gliders.

Results

Glider Density

Thirty-nine Sugar Gliders (13 males and 26 females) were captured a total of 46 times during the survey (Table 1). It was not possible to determine the number of additional adult gliders not captured, because nest box inspections had been conducted prior to the commencement of tagging.

Examination of the pouches of captured females showed that there were 14 pouch young and 26 nestling young (as indicated by strongly lactating nipples) in the population at the time of the survey. Hence the total population was at least 79 animals including all pouch young.

Population Structure

Trapping results suggested a greater proportion of females than males in the two older age classes (see Table 2) with 15 females captured compared with 8 males

Table 1. Numbers of Sugar Gliders captured at each trapping site at Tower Hill, November 1986 (numbers of recaptures in parentheses)

Site	Number Captured	
	Male	Female
Channel Track (equivalent to Site A of Suckling & Macfarlane 1983)	8(1)	18(1)
Motorcycle Track (equivalent to Site B of Suckling and Macfarlane 1983)	4(2)	5(0)
Office Block (see Fig. 1 of Suckling and Macfarlane 1983)	1(1)	3(2)
TOTAL	13	26

Table 2. Mean weights of Sugar Gliders captured at Tower Hill during November 1986.

Sex	Age (yr)	Weight (g)	N
Male	< 1	125	3
	1-2	142	8
	> 2	145	2
Female	< 1	114	4
	1-2	117	15
	> 2	128	7

in the 1-2 year age class and 7 females compared with 2 males in the > 2 year class.

Three of the female gliders captured during November 1986 had been tagged in May 1981. One of these females was estimated to be at least 2 years old in May 1981, so was likely to be at least 7.5 years old when captured during the present study.

Condition of captured gliders

All of the trapped gliders appeared to be in good health. Mean weights of animals captured at Tower Hill are presented in Table 2. Weights for both sexes compare favourably with weights recorded for animals at Willung (Suckling 1984).

Reproduction

Of the 26 females captured, 22 were more than one year old. Eight females had pouch young, fourteen others were lactating, one had produced young but ceased lactating, one showed signs of being in oestrus (Suckling 1984) and two had undeveloped pouches. The latter two animals were both assessed to have been less than one year old. Two other females assessed to have been less than one year old were breeding during the study. All females assessed to be over one year old were breeding.

Of the 23 females which had produced young in 1986, 20 had twins and the remaining 3 had single young. Mean litter size was 1.9.

Reproduction during 1986 probably commenced late in July or early in August, as assessed from the most advanced breeding females.

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Use of Artificial Hollows

Twenty-one Sugar Gliders were found in artificial hollows during the survey. A total of nine were occupied by gliders, but a further 15 showed signs of recent occupation (Table 3). This is consistent with the fact that groups of gliders use a number of different hollows, particularly during the breeding season (Golding 1979; Suckling 1980, 1984). A large proportion (51%) of the box-type artificial hollows were occupied by bees (Table 3).

At the office block site, 4 adult and 4 young gliders were detected in one artificial hollow; 4 adults were captured near this site. The young gliders observed were not yet independent of their parents, as they were seen to cling to the fur of the fleeing adults.

Discussion

Survival and status of Sugar Glider populations at Tower Hill

Populations of Sugar Gliders have now persisted at Tower Hill for almost eight years and this study has reinforced the conclusion of Suckling and Macfarlane (1983) which was that a population of Sugar Gliders had been successfully established at Tower Hill.

Average natality rate (number of young born per adult female) was 1.7, though it must be remembered that the breeding season had not been completed at the time of the survey. In spite of this the overall average natality was similar to that recorded in May 1981 and it appears that reproduction is continuing at a similar rate to that recorded during the 1981 study.

It was not possible to compare recruitment rates with those recorded during 1981

because the two surveys were conducted at different times of year.

The current survey indicates that there are now more Sugar Gliders in the Reserve than were detected during the 1981 study. Although the number of captures during 1986 (39) was only marginally greater than the number of captures during 1981 (32), likely survival rates of pouch young (see Suckling 1984, Suckling and Macfarlane 1983) suggest an autumn 1987 population of at least 60 animals (i.e. at least 39 adults, including 26 females, alive during this study, and an average recruitment of one young per adult female). It is relevant that trapping resulted in the capture of 10, 14, 8 and 7 new individuals respectively on each successive day of the survey. These figures suggest that continued trapping would have revealed a greater number of individual gliders. Similarly, recaptures numbered 1, 2 and 4 on the second, third and fourth mornings of trapping respectively, further suggesting that the total population was much greater than that detected.

Another factor to be considered is that gliders were probably occupying a larger area than in 1981, because the habitat had improved (i.e. trees were larger and there was more widespread natural shelter). It is therefore likely that trapping sampled a smaller proportion of the total population than was the case in 1981. Further work is required to confirm the wider distribution of gliders in the reserve.

The survival for a further 5.5 years of at least three female gliders from a total of 17 females tagged during the 1981 study indicates a higher survival rate than in a wild population studied by Suckling

Table 3. Use of artificial hollows by Sugar Gliders at Tower Hill November 1986.

Type of Nest Hollow	Number Inspected	Occupied by Sugar Gliders	With Signs of Recent Occupation	Apparently Unused	Occupied by Bees	Occupied by Starlings or Other Species
Box	59	8	12	6	30	3
Hollow limb	8	1	3	3	1	-
Pipe	1	-	-	1	-	-

(1984). The latter study found that less than 8 percent of one year old females survived to reach four or more years of age. In the present study at least two of the seven females estimated to be approximately one year old in May 1981 survived until at least November 1986. This represents a very high survival rate for females and suggests that the habitat at Tower Hill is highly suited to *P. breviceps*.

The age structure, population size, reproductive success, survival and condition of the Sugar Glider populations at Tower Hill substantiate the conclusion that the species has been established (see also Suckling and Macfarlane 1983; Macfarlane and Suckling 1984).

Management Implications

The continued survival of Sugar Gliders at Tower Hill, despite the absence of supplementary feeding with dilute honey solution, is sufficient indication that existing natural food sources are adequate.

Data on occupation of artificial hollows (13% in 1986 compared with 24% in 1981) indicates a lower use by gliders than was recorded during the 1981 study. This is probably partly due to the increase in natural shelter sites such as decorticated bark and possibly even some small hollows. However, it may also be partly due to the high use of artificial hollows by bees. The data on use of artificial hollows suggest that the hollow-limb type is less suited to occupation by bees. Bees are also more readily removed from this type of artificial hollow because the lids are removeable. The erection of further nesting sites of the hollow-limb type in sites where the habitat is suitable in other respects, should enable the gliders to further increase their populations. The recommendation made by Suckling and Macfarlane (1983) of an optimum density of 3-5 artificial hollows per ha of suitable habitat, are still relevant to the management of glider populations at Tower Hill.

Until such time as the planted trees at Tower Hill form hollows, it will be necessary to ensure that nest sites are provided. Local managers should determine whether it is better to provide additional hollows to replace those which become occupied by bees (or are rendered unsuitable for any other reason), or to carry out maintenance work on the existing hollows, or to adopt some combination of both approaches.

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